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Older (but not younger) preschoolers reject incorrect knowledge claims

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As epistemic and normative learners, children are dependent on their developing skills for evaluating others' claims. This competence seems particularly important in the current digital age in which children need to discern valid from invalid assertions about the world in both real-life and virtual interactions to ultimately gather and accumulate robust knowledge. We investigated whether younger and older preschoolers (N = 48) understand that a speaker's knowledge claim ('I know where X is') may be correct or incorrect given objectively accessible information (about whether the speaker had perceptual access to a critical event). We found that both younger and older preschoolers accepted correct knowledge claims that matched observable reality, but that only older preschoolers reliably rejected incorrect knowledge claims that did not match reality (the speaker lacked perceptual access). Nevertheless, a considerable proportion of younger preschoolers both rejected incorrect knowledge claims and gave valid explanations, suggesting that the ability to scrutinize epistemic claims develops gradually from around 3 to 4 years of age. These findings may help integrate research on children's norm and theory of mind development.

Statement of contribution

What is already known on this subject?

- Preschoolers understand that non-epistemic claims (e.g., 'This is an X!') may be correct or incorrect, and they track a speaker's relevant characteristics in testimonial situations.
- It is not known what preschoolers understand about the validity of epistemic (knowledge) claims (e.g., 'I know that X').

What does this study add?

- Younger and older preschoolers accepted correct knowledge claims (children observed that a speaker saw a critical event and was thus knowledgeable).
- Only older preschoolers reliably rejected incorrect knowledge claims (the speaker did not see the critical event).
- Nevertheless, a considerable proportion of younger preschoolers showed competence in their evaluation of, and reasoning about, incorrect knowledge claims.
- Findings suggest that the ability to evaluate epistemic claims develops gradually from around 3 to 4 years of age.

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In their everyday social interactions, children are confronted with different types of speech acts many of which are assertions about the world. Clearly, assertions do not exist in a descriptive vacuum, but are an inherent part of socio-normative practices and thus subject to being challenged, scrutinized, and subsequently accepted or rejected (Brandom, 1994; Sellars, 1963).

In many situations, children cannot verify claims directly, but need to rely on testimony others provide. Much research suggests that they often do so in competent and selective ways, for instance, by paying attention to cues of trustworthiness, such as reliability and accuracy (Harris, 2012; Jaswal, Croft, Setia, & Cole, 2010; Koenig, Clement, & Harris, 2004; Koenig & Harris, 2005a; Koenig & Harris, 2005b; Nurmsoo & Robinson, 2009a; Robinson, Butterfill, & Nurmsoo, 2011; Stephens, Suarez, & Koenig, 2015). On the other hand, however, children (and, in some contexts, even adults) also seem to have a tendency to uncritically accept testimony, even when it contradicts what they have perceived or learnt (Gilbert, Krull, & Malone, 1990; Jaswal, 2010; Jaswal *et al.*, 2010, 2014). And so it seems vital for children to develop skills for assessing the validity of others' claims in light of their own experience, beliefs, and knowledge. Perhaps particularly important in our digital age in which we need to navigate the jungle of apparent facts and claims coming from many different sources are *epistemic claims*: others' claims about *knowing* some state of affairs (e.g., 'I know that X!'). One reason for the importance of scrutinizing *knowledge claims* is that they encompass both the immediate evaluation of the validity of the proposition and the potential to categorize someone as a trustworthy epistemic source given that a knowledge claim, if correct, provides evidence for such trustworthiness. In this study, our goal was to investigate whether preschoolers understand that a speaker's knowledge claim may be valid or invalid, that is, correct or incorrect given observable reality (or 'factual truth', i.e., objectively accessible information).[1] The broader aim of this work is to help integrate research on children's norm and theory of mind development. That is, previous research children's developing norm psychology has mainly dealt with children's understanding of practical norms, such as conventional or moral norms (Schmidt & Tomasello, 2012; Turiel, 2006), and the theory of mind literature has predominantly focused on children's understanding of mental states and of processes of knowledge acquisition (Kuhn, Cheney, & Weinstock, 2000; Miller, Hardin, & Montgomery, 2003; Perner & Roessler, 2012; Wellman & Liu, 2004). The evaluation of knowledge claims in this study, however, required children to use both their theory of mind abilities (understanding perception as a source of knowledge) and basic normative capacities (categorizing a claim as correct or incorrect given some standard, such as observable reality).

Children's understanding and evaluation of others' claims

To successfully learn from others and gain a robust and broad understanding of the world, children need to rely on testimony from others and to develop critical skills for differentiating between trustworthy and untrustworthy sources of knowledge (Mills, 2013; Sperber *et al.*, 2010). Much research on children's epistemic trust suggests that preschoolers track speakers' relevant characteristics (e.g., prior reliability, accuracy, confidence) when deciding whom to learn from in social interactions (Clément, 2010;

[1] *Note that one could use the opposite pair 'justified–unjustified' instead of 'correct–incorrect' when discussing the validity of epistemic claims. As we are interested in one of the clearest cases of evaluating knowledge claims against objectively accessible information (facts), we use the correct–incorrect distinction here.*

Harris, 2012; Koenig & Harris, 2005b; Nurmsoo & Robinson, 2009a; Nurmsoo & Robinson, 2009b; Robinson & Nurmsoo, 2009; Stephens *et al.*, 2015). Besides testimonial situations in which children face the epistemological problem whom to trust and cannot verify speakers' claims directly, there are also more 'objective' situations in which children are in a position to immediately assess the validity of speakers' assertions (Koenig *et al.*, 2015). For instance, when others make simple non-epistemic claims (i.e., without the form 'I know') about some state of affairs (e.g., 'This is an X!'), toddlers are surprised as indicated by increased looking time (Koenig & Echols, 2003), and 2-year-olds reject those assertions if they do not match reality (Lyon, Quas, & Carrick, 2013; Pea, 1982). From around 3 years of age then, children begin to differentiate between different types of speech acts with different directions of fit (Anscombe, 1957; Searle, 1969) and direct their criticism accordingly to speakers who do not describe observable reality correctly (by non-epistemic assertion, word-to-world direction of fit) and to actors who do not perform actions as prescribed (by imperative, world-to-word direction of fit; Rakoczy & Tomasello, 2009). That is, even young children understand that assertions can be assessed as to whether they match reality and that imperatives are aimed at changing the world (e.g., have someone perform a certain action). From around 4 years of age, children reject future-directed assertions (predictions) that do not hold up to reality (Lohse, Gräfenhain, Behne, & Rakoczy, 2014). Moreover, when hearing non-epistemic claims (e.g., 'Pangolins are brown'), preschoolers (in particular, 3-year-olds) tend to attribute knowledge rather to a speaker whose assertion is objectively verifiable (e.g., via an agent's visible properties) than to a speaker whose claim is not directly verifiable (Koenig *et al.*, 2015). And when adults' assertions are in conflict with what children have just experienced (given objectively accessible information), young preschoolers (2- to 3-year-olds) seem to have difficulty in rejecting or not basing their actions on those assertions and are thus perhaps overly trusting (Jaswal, 2010; Jaswal *et al.*, 2010). Individual differences in inhibitory control may at least in part explain young children's potential bias to trust others' testimony (Jaswal *et al.*, 2014).

None of these studies, however, assessed children's understanding and evaluation of others' epistemic (knowledge) claims (e.g., 'I *know* that X'). Here, we were interested in children's evaluation of knowledge claims given objectively accessible information (a factual context), such as a speaker's perceptual access to a critical event. Knowledge claims differ from non-epistemic claims (e.g., 'This is an X!') in two important ways: First, although non-epistemic claims may often imply that the speaker claims to know some state of affairs, 'I know' statements indicate most clearly and explicitly that the speaker claims to possess knowledge with a high degree of confidence and commitment to her epistemic state (in contrast to other epistemic verbs, such as guess, think, suppose). And second, while non-epistemic claims may be directly assessed without necessarily requiring reference to other facts, knowledge claims are putative facts about an unobservable (mental) world that need to be assessed in relation to other facts (e.g., a speaker's perceptual access) that speak in favour or disfavour of the claim put forward. To assess a speaker's knowledge claim as correct or incorrect in a factual context in which a speaker's perceptual access to a critical event is key, children need to possess at least two conceptual skills: (1) a rudimentary epistemological understanding, namely, that perception (one major epistemic source) plays a causal role – not just an associative one – in knowledge formation, as evidenced most clearly using perceptual access (or lack thereof) as an explanation for why someone knows or does not know X (O'Neill, Astington, & Flavell, 1992; Wimmer, Hogrefe, & Perner, 1988; Wimmer, Hogrefe, & Sodian, 1988); and (2) a rudimentary normative capacity (that makes use of the former

ability), that is, to evaluate whether an action, here an assertive speech act (which, according to classical accounts, aims at truth; Dummett, 1959; Searle, 1969), meets a standard, here observable reality or 'factual truth' – a speaker's prior (lack of) perceptual access – from which follows the epistemic inference that a speaker knows or does not know X (Schmidt & Rakoczy, 2018a; Schmidt & Rakoczy, 2018b).

Children's understanding of the seeing-knowing relation

Evaluating the validity of knowledge claims, we suggest, requires both basic normative and theory of mind capacities. Regarding the latter, children's understanding of the relation between seeing and knowing has been intensively investigated in the past and the results based on different paradigms (e.g., behavioural or verbal) are somewhat mixed. On the one hand, 2-year-olds, and even infants, are sensitive to others' informational access to critical events and modulate their descriptive expectations and communicative behaviour accordingly (Baillargeon, Scott, & He, 2010; Liszkowski, Carpenter, Striano, & Tomasello, 2006; Liszkowski, Carpenter, & Tomasello, 2008; O'Neill, 1996; Poulin-Dubois, Sodian, Metz, Tilden, & Schoeppner, 2007; Sodian & Thoermer, 2008). And 2-year-olds talk about knowledge and ignorance (mainly in the first and second person) in social interactions (Harris, Ronfard, & Bartz, 2017; Harris, Yang, & Cui, 2017) – all of which may indicate more implicit awareness of others' epistemic states, which may not be sufficient for an explicit judgement of whether a knowledge claim (with the propositional content that the speaker knows X) is correct or incorrect. On the other hand, there is evidence that it is not before 3–4 years of age that children show reliable competence in seeing-knowing tasks requiring them to explicitly attribute knowledge (or ignorance) to third parties who (do not) have visual access to some event or object (O'Neill *et al.*, 1992; Pillow, 1989; Pratt & Bryant, 1990; Sodian & Wimmer, 1987; see Sodian, Thoermer, & Dietrich, 2006; for converging evidence from a non-verbal task). And some studies suggest that when attributing knowledge and ignorance, 3-year-olds seem to have difficulty with systematically considering others' perceptual access to relevant events (perhaps especially when it does not match their own perceptual access), and, in contrast to older preschoolers, they may lack a firm understanding of the causal link between perception and knowledge formation (Marvin, Greenberg, & Mossler, 1976; Mossler, Marvin, & Greenberg, 1976; Povinelli & de Blois, 1992; Ruffman & Olson, 1989; Wimmer, Hogrefe, & Perner, 1988). For instance, Wimmer, Hogrefe, and Perner (1988) found that 3-year-olds had no issues with stating *that* they knew the identity of an object after having had visual access, but that they were not able to explain *how* (e.g., via visual access) they themselves or another person had acquired knowledge about some state of affairs. More generally, 3-year-olds might be limited in their ability to coordinate two (conflicting) 'objective' aspects of a situation (e.g., individual mental states vs. rules; different types of rules; Kalish, 1998; Perner & Roessler, 2012; Schmidt, Hardecker, & Tomasello, 2016). Thus, they might have more difficulty with an epistemic mismatch (in which there are, prima facie, two 'objective' facts that need to be reconciled: the fact that the speaker apparently knows X, and the fact that the speaker lacked visual access) than with a non-epistemic mismatch (in which there is only one 'objective' fact, e.g., an agent's action, the speaker refers to directly; Rakoczy & Tomasello, 2009).

In the context of epistemic trust, findings are mixed as to whether children consider others' lack of perceptual access as a cause (and thus excuse) for making mistakes. When tasks focused on identifying hidden objects (i.e., episodic knowledge), 3- to 5-year-old children took into account an informant's previous inaccuracy (excused by a lack of

perceptual access) when deciding whether to trust the informant in a test situation in which the informant was better informed than children (Nurmsoo & Robinson, 2009a; Robinson & Nurmsoo, 2009). When, however, the task was about generalizable information (i.e., semantic knowledge), such as labelling unfamiliar objects, 3- to 7-year-old children ignored epistemic aspects (a speaker's perceptual access) and focused on prior accuracy when deciding whom of two speakers to trust (Nurmsoo & Robinson, 2009b). Thus, the type of social learning situation (e.g., semantic vs. episodic knowledge) may influence children's attention to, or consideration of, epistemic aspects, such as a speaker's perceptual access to relevant information.

The present study

In this study, we sought to investigate whether younger and older preschoolers understand and evaluate knowledge claims (about the location of an object, 'I know where X is!') in a factual context. That is, children witnessed a speaker who had or did not have perceptual access to a critical hiding event, thus making her subsequent knowledge claim correct or incorrect given the epistemic consequences (knowledge vs. ignorance) that follow from observable reality. We chose to investigate younger preschoolers from 3 to 4.5 years of age and older preschoolers from 4.5 years onwards, because – as explicated above –potentially important conceptual and performance skills related to theory of mind, executive control, and norm understanding develop from around 4 to 4.5 years of age (Garon, Bryson, & Smith, 2008; Perner & Roessler, 2012; Schmidt *et al.*, 2016; Wellman, Cross, & Watson, 2001). We predicted that both younger and older preschoolers would reliably accept correct knowledge claims, but that only older preschoolers would reliably reject incorrect knowledge claims, given younger preschoolers' difficulty with understanding the causal link between seeing and knowing, with coordinating conflicting 'objective' aspects simultaneously (i.e., an epistemic mismatch situation), and with inhibiting prepotent responses. Moreover, based on the hypothesized importance of a causal understanding of the role of perception in knowledge formation, we predicted that children who reject incorrect knowledge claims are more likely to provide adequate explanations (e.g., lack of perceptual access) for why a speaker does not know something than children who accept incorrect knowledge claims.

Method

Participants

Forty-eight younger (n = 24; 36–54 months; M = 4 years, 0 months; 12 girls) and older (n = 24; 55–71 months, M = 5 years, 1 months; 12 girls) preschoolers participated in the study. Children came from mixed socio-economic backgrounds from a large German city and were recruited via urban day care centres (in which testing took place). Parents provided written informed consent. Three additional children were tested, but excluded because of language and comprehension difficulties (1) or experimenter error (2).

Design

In a within-participants design, all children received a knowledge claim task with two counterbalanced conditions: a perceiving and a non-perceiving puppet. The knowledge claim task was preceded by a warm-up session (playing with a ball). In the knowledge

claim task, the order of the puppet speaking first was counterbalanced between children for each age group. Moreover, the perceiving and non-perceiving puppet's position and the location of the hidden object (left vs. right from the child's viewpoint) were counterbalanced between children for each age group.

Procedure

Two experimenters conducted the study: E1, the coordinator, and E2, who operated the two puppets (seal and owl). The child, E1, and E2 sat at a table. E1 sat to the child's left, and E2 sat *vis-à-vis* to the child (thus the child faced the two puppets).

In the knowledge claim task, E1 first presented two boxes and a gem. To engage the child in the task, E1 told the child that the gem was a gift for the child. Then, she announced that she was going to put the gem in one of the boxes, asking the child to pay attention to whether the two puppets really knew where the gem was ('These are my boxes and here I have a gem. The gem is for you [referring to the child]. I will put it in one of the boxes and you [referring to the child] have to pay attention whether they [puppets] really know where the gem is.'). This was followed by the non-perceiving puppet being turned around by E1 such that the puppet's back faced the table and the puppet could not 'see' the upcoming events. Both E1 and the non-perceiving puppet explained to the child that the puppet did not 'see' anything at all (E1: 'The puppet (e.g., owl) is going to turn around and does not see anything at all. Look, the owl does not see what we are doing!'; non-perceiving puppet: 'Yes, I do not see what you are doing!'). Then, E1 put the gem in one of the two boxes. The perceiving puppet then looked ostensively and made an affirming interjection ('Ah!'), to make clear that the perceiving puppet saw in which box E1 put the gem. Then, the non-perceiving puppet was turned around by E1 such that it faced the table again. Importantly, during the whole introductory phase, no epistemic vocabulary was used to have children evaluate independently whether the speaker knew or did not know some state of affairs.

Theron one of the puppets (counterbalanced) made a knowledge claim ('I know where the gem is.'), followed by E1 asking the child to evaluate (accept or reject) the knowledge claim, 'Does the owl know where the gem is?'. Then, E1 prompted the child to explain her answer ('And why does the owl (not) know?'). This procedure was then repeated with the second puppet.

Coding and reliability

All sessions were transcribed and coded from videotape by a single observer. A second independent observer, blind to the hypotheses and conditions of the study, transcribed and coded a random sample of 25% of all sessions for reliability.

Children's evaluation of the knowledge claims (dichotomous variable: positive or negative response to E1's question) and their explanation of their judgement were coded. Children's explanation of their evaluation ('And why does he (not) know?') was considered as valid explanations, if they referred directly or indirectly to the puppet's perceptual state (e.g., 'Because she saw it.', for the perceiving puppet; e.g., 'Because she did not see it', 'Because she turned around', for the non-perceiving puppet). Other responses considered invalid were incorrect references to the puppet's perceptual state (e.g., 'She [the perceiving puppet] did not see it.'), references to reality (e.g., 'It is in the red box.'), circular explanations (e.g., 'She just knows it.'), irrelevant explanations (e.g., 'Because she has good eyes.'), or no explanation (including 'Don't know'). Inter-rater reliability was very good, Cohen's $\kappa = 1$ (evaluation of knowledge claims), $\kappa = 1$ (explanation).

Statistical analysis

Statistical analysis was run in R, version 3.3.2 (R Core Team, 2016). To account for the non-independence of the data (i.e., repeated observations per child), we used generalized linear mixed models (GLMM) with binomial error structure for comparing children's performance in the two conditions (perceiving and non-perceiving) separately for each age group (Baayen, 2008; Bates, Maechler, Bolker, & Walker, 2013). Unstandardized parameter estimates (*b*), standard errors, 95% confidence intervals (CIs), and odds ratios (*ORs*) were obtained from the full model. Models included condition and gender as fixed effects and participant as a random effect. We tested for the effect of condition by comparing the fit of the full model (including all fixed and random effects) with the fit of a reduced model (without condition) using a likelihood ratio test (Dobson, 2002). There were no significant effects of gender. Two children from the younger age group did not respond to the evaluation question on one trial each (thus, they could not be asked for explanation). Therefore, analyses per condition were based on 23 younger and 24 older children.

Results

Evaluation of knowledge claims

Figure 1 depicts the proportion of children accepting the perceiving and non-perceiving puppets' knowledge claims. We predicted age differences in the non-perceiving condition only. Thus, we first conducted a binomial GLM on children's acceptance of the non-perceiving puppet's knowledge claim with age as a continuous predictor (z-transformed). We found a significant effect of age, $\chi^2(1) = 11.36$, $p < .001$, suggesting that younger preschoolers were more likely to accept the non-perceiving puppet's knowledge claim than older preschoolers. To test whether the proportion of children accepting each knowledge claim was significantly different from chance (.50), we conducted planned exact binomial tests (two-tailed). Older preschoolers reliably accepted knowledge claims by the perceiving puppet (96% of children, $p < .001$) and reliably rejected knowledge claims by the non-perceiving puppet (88%, $p < .001$). Younger preschoolers, however, reliably accepted knowledge claims by the

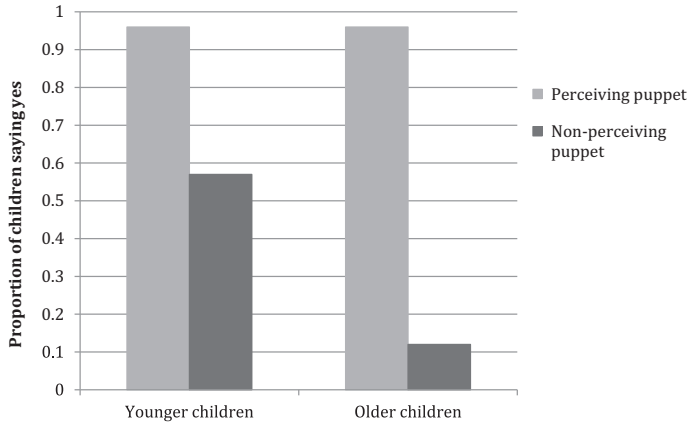

Figure 1. Proportion of children accepting the knowledge claims of the perceiving and non-perceiving puppet.

perceiving puppet (96%, $p < .001$), but performed at chance level for the non-perceiving puppet (56%, $p = .68$). Nevertheless, both younger and older preschoolers were more likely to accept knowledge claims by the perceiving puppet than by the non-perceiving puppets as indicated by two binomial GLMMs: younger children, $\chi^2(1) = 11.06$, $p < .001$, $b = 2.86$, $SE = 1.11$, CI [1.04, 5.84], OR = 17.54; older children, $\chi^2(1) = 39.81$, $p < .001$, $b = 5.08$, $SE = 1.19$, CI [3.11, 8.16], OR = 160.93.

In the younger age group, 11 children accepted both types of claims (suggesting a yes bias), no child rejected both types of claims (suggesting a no bias), 10 children accepted the correct, and rejected the incorrect, knowledge claim (correct response pattern), and one child showed the opposite pattern, exact McNemar's test, $p = .012$. In the older age group, two children accepted both types of claims, no child rejected both types of claims, 21 children accepted the correct, and rejected the incorrect, knowledge claim, and one child showed the opposite pattern, $p < .001$.

To obtain a more precise view of developmental patterns in preschoolers' evaluation of incorrect knowledge claims in the non-perceiving condition, we subdivided the age groups into 3-year-olds ($n = 13$; range = 3.0–4.1), young 4-year-olds ($n = 10$; range = 4.2–4.6), old 4-year-olds ($n = 14$; range = 4.7–5.1), and 5-year-olds ($n = 10$; range = 5.2–5.11)[2] and conducted four binomial tests. Sixty-nine per cent of 3-year-olds ($p = .27$), 40% of young 4-year-olds ($p = .75$), 14% of old 4-year-olds ($p = .01$), and 10% of 5-year-olds ($p = .02$) accepted the non-perceiving puppet's knowledge claim. Moreover, 3-year-olds and young 4-year-olds were equally likely to accept the non-perceiving puppet's knowledge claim, Fisher's exact test, $p = .22$, but old 4-year-olds were more likely than 3-year-olds to reject the non-perceiving puppet's knowledge claim, $p = .006$.

Explanations

Children were also prompted to explain their evaluation. Valid explanations were direct and indirect references to the puppet's perceptual state (e.g., seeing, non-seeing). All other explanations (e.g., references to reality, i.e., the location of the hidden object) or lack of clear explanations were considered invalid (see Coding and Reliability for details). For the perceiving puppet (see Table 1), valid explanations were given by 21 of 24 older children (88%) and by 12 of 23 younger children (52%). For the non-perceiving puppet (see Table 1), valid explanations were given by 19 of 24 older children (79%) and by 10 of 23 younger children (43%).

With respect to the four age subgroups (see above), 31% (perceiving condition) and 31% (non-perceiving condition) of 3-year-olds referred to reality in their explanations, whereas none of the older age subgroups did. Only a few children gave incorrect references to the puppet's perceptual state and this occurred only in the non-perceiving condition (7% of old 4-year-olds and 10% of 5-year-olds). Independent of condition, irrelevant answers were given by 21% of 3-year-olds, 20% of young 4-year-olds, 7% of old 4-year-olds, and no 5-year-old, and no answer was given by 29% of 3-year-olds, 20% of young 4-year-olds, 21% of old 4-year-olds, and no 5-year-old.

[2] *Condition (perceiving, non-perceiving puppet) was roughly evenly counterbalanced for these subgroups: 57% of 3-year-olds, 40% of young 4-year-olds, and 50% of both old 4-year-olds and 5-year-olds received the non-perceiving condition first.*

Relation between evaluation of knowledge claims and explanation

Across age, there were no significant associations between children's evaluation of the perceiving puppet's knowledge claim and the validity of their explanation (Table 1), Fisher's exact tests, p's > .47. However, as predicted, there were significant associations between children's evaluation of the non-perceiving puppet's knowledge claim and the validity of their explanation (Table 1): younger children, $p = .039$, $\varphi = .47$; older children, $p = .005$, $\varphi = .74$, such that children who rejected the non-perceiving puppet's knowledge claim were more likely to give valid explanations, whereas children who accepted the non-perceiving puppet's knowledge claim were more likely to give invalid explanations (but note that only a few older children gave invalid explanations). Moreover, 7 younger (1 of 12 three-year-olds and 6 of 10 young 4-year-olds) and 17 older preschoolers evaluated both knowledge claims (perceiving and non-perceiving puppet) correctly and gave valid explanations in both conditions. Finally, for younger preschoolers who accepted both types of claims (a yes bias pattern), two children gave valid explanations in both conditions, two children gave valid explanations for the perceiving puppet and invalid explanations for the non-perceiving puppet, one child showed the opposite pattern, and six children gave invalid explanations in both conditions.

Again, to obtain a more precise view of younger preschoolers' performance in the non-perceiving condition, we assessed 3-year-olds' and young 4-year-olds' (same subgroups as above) performance (Table 1). There was no significant association between evaluation of the non-perceiving puppet's knowledge claim and the validity of children's explanation for 3-year-olds, Fisher's exact test, $p = 1$, but we found a significant association for young 4-year-olds, $p = .03$, $\varphi = .80$.

Table 1. Association between evaluation and explanation

	Perceiving		Non-perceiving	
	Explanation		Explanation	
	Valid	Invalid	Valid	Invalid
Preschoolers' age				
Younger (3- to young 4-year-olds)				
Evaluation				
Accept	12	10	3	10
Reject	0	1	7	3
Older (old 4- to 5-year-olds)				
Evaluation				
Accept	20	3	0	3
Reject	1	0	19	2
Age subgroups				
3-year-olds				
Evaluation				
Accept	4	8	2	7
Reject	0	1	1	3
Young 4-year-olds				
Evaluation				
Accept	8	2	1	3
Reject	0	0	6	0

Discussion

In today's digital age, the ability to scrutinize apparent facts and claims seems more important than ever. Besides non-epistemic claims about facts (e.g., 'This is an X!'), people often make epistemic claims (e.g., 'I know that X!'), explicitly suggesting that they know a certain state of affairs – a claim that can be correct or incorrect. This study investigated children's developing understanding of the validity of knowledge claims, an important aspect of their norm and theory of mind development. Children witnessed a speaker claiming knowledge about the location of a hidden object ('I know where X is!'), and we varied the speaker's prior perceptual access to the critical hiding event. When the speaker had seen the hiding event, both younger and older preschoolers predominantly accepted the speaker's knowledge claim. When the speaker had not seen the hiding event, however, only older preschoolers reliably rejected the speaker's knowledge claim while younger children performed at chance level. Nonetheless, even younger preschoolers (from 4 years onwards) who rejected the speaker's incorrect knowledge claim mostly gave valid explanations for why the speaker does not know X, suggesting that the ability to evaluate epistemic claims develops gradually from around 3 to 4 years of age.

These findings go beyond prior research on children's norm understanding, epistemic trust, and early epistemology by introducing the challenge to assess someone's knowledge claim – an apparent 'objective' fact – considering observable reality (previous perceptual state including epistemic consequences) that supports or conflicts with the claim. For instance, 3-year-olds readily reject incorrect non-epistemic assertions (e.g., 'This is an X'; Pea, 1982; Rakoczy & Tomasello, 2009), but the current work investigated epistemic assertions and suggests that it is not until 4–5 years of age that children reliably reject incorrect knowledge claims. This result may be, in part, due to the fact that epistemic claims are more complex than non-epistemic claims: In our study, children had to coordinate and reconcile two competing 'objective' facts in cases of epistemic mismatch (the fact that the speaker apparently knows X, and the fact that the speaker lacked visual access), something that younger preschoolers seem to have trouble with (Kalish, 1998; Perner & Roessler, 2012; Schmidt *et al.*, 2016). Note that we did not investigate children's normative understanding in the deontic or axiological sense here, that is, their judgement or expectation that a speaker ought to make correct or even justified claims (or else be blamed, etc.), or that it is bad to make incorrect epistemic claims. Rather, we tested for children's ability to evaluate whether an assertion (with the propositional content that the speaker knows X) is correct or incorrect (according to the norm of truth), that is, whether it matches the epistemic inference (knowledge vs. ignorance) which follows from observable reality (the speaker's perceptual access or lack of perceptual access). Thus, correctness here is evaluated in a factual context and refers to the content or the object of the speech act, but not to the very act of uttering the speech act with a certain content (Williams, 2002). Our study may help integrate the normativity and theory of mind literatures. That is, normativity research has mostly focused on children's evaluation of others' actions (e.g., in a game or moral context; Schmidt & Tomasello, 2012; Turiel, 2006), and research on theory of mind and early epistemology has mostly focused on children's attribution of mental states, prediction of others' actions, and conditions for knowledge formation (Kuhn *et al.*, 2000; Miller *et al.*, 2003; Perner & Roessler, 2012; Wellman & Liu, 2004; Wellman & Miller, 2008). In our study, however, children were required to consider others' potential epistemic relation to the world (making use of their theory of mind abilities) and to assess the validity of an epistemic claim (making use of both their basic normative and theory of mind abilities).

Our findings also fit with prior work on epistemic trust suggesting that young preschoolers around 3 years of age may be overly credulous when adults' non-epistemic claims conflict with their own experience (Jaswal, 2010; Jaswal *et al.*, 2010, 2014). It is possible that younger preschoolers who accepted incorrect knowledge claims took the non-perceiving puppet's speech act at face value and then had issues coming up with an adequate explanation for their positive evaluation (in particular, 3-year-olds often referred to reality, e.g., 'It is in the red box'). Interestingly, younger children (mainly 3-year-olds) who showed a 'yes bias' (accepting both types of knowledge claims) often gave invalid explanations for both incorrect and correct knowledge claims. And while 3-year-olds' evaluation of incorrect knowledge claims was not related to the validity of their explanations, we found systematic individual differences in young 4-year-olds: Children who rejected incorrect knowledge claims tended to provide valid explanations, whereas children who accepted incorrect knowledge claims tended to provide invalid explanations. And about two-thirds of young 4-year-olds both evaluated the two types of knowledge claims correctly and gave valid explanations for both claims. Thus, younger preschoolers' chance performance for incorrect knowledge claims suggests that mixed results from previous research on children's understanding of the seeing-knowing relation may be the result not only of methodical differences, but of a conceptual deficit at the group level (e.g., an immature understanding of the causal connection between seeing and knowing) or of a performance deficit with large individual differences (e.g., in inhibitory control), or both.

One might wonder whether younger preschoolers' difficulty with evaluating incorrect knowledge claims condition was mainly driven by their difficulty with understanding the causal connection between seeing and knowing or perhaps also with evaluating knowledge claims per se. Three points are important in this respect.

First, younger preschoolers reliably accepted correct knowledge claims in the perceiving condition and, as a group, were responsive to the puppets' perceptual access, showing more acceptance of correct versus incorrect knowledge claims. This suggests that younger preschoolers were able to competently assess correct knowledge claims (when the claim matched the observed facts) and that they were not just blindly accepting the invalid knowledge claim in the non-perceiving condition. Hence, they did not have issues with evaluating knowledge claims per se (and did not just show a 'yes bias' across conditions).

Second, younger preschoolers did not reliably reject incorrect knowledge claims but performed at chance level, which, at the individual level, could be a result of uncertainty or of truly understanding that the knowledge claim was incorrect. Our findings that 3-year-olds' evaluation of incorrect knowledge claims was unrelated to the validity of their explanation, but that young 4-year-olds' evaluation of knowledge claims was systematically related to their explanations, suggests that 3-year-olds have severe difficulty with the causal understanding of seeing and knowing and that developmental change occurs from around four years of age. These results are in line with findings suggesting that 4-year-olds perform better at attributing ignorance than 3-year-olds (Friedman, Griffin, Brownell, & Winner, 2003; Hogrefe, Wimmer, & Perner, 1986). Nevertheless, future work could use the current paradigm and omit the puppets' knowledge claims to differentiate more directly between children's causal understanding of seeing and knowing and their ability to assess knowledge claims in the present seeing-knowing context.

And third, from a theoretical perspective, the evaluation of a knowledge claim, qua definition, presupposes the ability to assess information or evidence that speak in favour or disfavour of the claim put forward. And here, understanding perception as a source of

knowledge is key. And if younger preschoolers have performance issues with handling two types of putative facts (the knowledge claim and the puppet's prior lack of perceptual access), they, one could argue, become competence issues in the case of the evaluation of knowledge claims. This is because such an evaluation is a normative capacity that necessitates the ability to compare an action (the knowledge claim) with some standard (observable reality, the facts) and to infer whether the claim is correct or incorrect given objectively accessible information (Schmidt & Rakoczy, 2018a; Schmidt & Rakoczy, 2018b).

At first glance, younger preschoolers' difficulty with rejecting incorrect knowledge claims in our study seems at odds with findings suggesting that even 3-year-olds excuse prior inaccuracy when it can be explained by lack of perceptual access and thus ignorance (Nurmsoo & Robinson, 2009a; Robinson & Nurmsoo, 2009). In those studies, however, children were required to handle only one fact about the observable world at a time, such as a speaker's uninformative access. In our study, children were required to process an alleged fact about the unobservable world ('I know that X') and its relation to a fact about the observable world (i.e., the speaker's prior perceptual access) – and come to a conclusion about whether the speaker's knowledge claim is correct or incorrect, which might presuppose more robust social-cognitive (theory of mind) and cognitive (inhibitory control) abilities. Interestingly, and related to our findings of a relation between children's evaluation of knowledge claims and their explanation, Robinson and Nurmsoo (2009) found that 3- to 5-year-olds' who tended to explain a puppet's mistakes by her ignorance or false belief were more likely (than children who did not use epistemic explanations) to believe the puppet (and thus excuse previous errors) when it was better informed than they were about the content of a box. Thus, future work should look more closely at interrelations between children's theory mind abilities and their understanding of epistemic and non-epistemic claims.

Moreover, future research could vary children's own informational state so that it matches the third party's informational state or not. It may be that younger preschoolers profit from congruency in perceptual access (Koenig *et al.*, 2015; Ruffman & Olson, 1989), but such a finding would call into question the robustness of young children's understanding of the validity of knowledge claims. Furthermore, future research may investigate the (social-)cognitive mechanisms underlying children's developing ability to assess epistemic claims.

Together, the present findings show that preschoolers differentiate between correct and incorrect knowledge claims and that this ability develops – with substantial individual variation – gradually from around 3 to 4 years of age. These findings go beyond prior work on children's understanding of practical norms or non-epistemic assertions, testimony, and the seeing-knowing relation, and bridge these literatures, opening new avenues for future research on children's developing understanding of the validity of speech acts. It is possible that preschoolers start off with a strong focus on whether claims and assertions match observable reality (as prescribed by the norm of truth) and only later consider other normative factors, such as whether claims are backed by reasons (independent of assessments of truth).

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